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PATENT APPLICATION INCLUDING:

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Inventors:	Dean Menchaca Rivera
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PATENT APPLICATION

42526-3600

ELECTRO-ACOUSTIC TRANSDUCER

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ELECTRO-ACOUSTIC TRANSDUCER

BACKGROUND OF THE INVENTION

1. Field of the Invention.

[0001]

The present invention relates generally to improvements in transducers and more particularly pertains to new and improved electroacoustic drivers wherein the transducer attaches to a large surface and in response to electrical signals cause that surface to move and create sound waves.

2. Description of Related Art.

[0002]

Those concerned with the development of electroacoustic transducers for driving large surfaces have continually been concerned with need for providing sufficient power to drive the large surfaces, removing the heat generated by units that have sufficient power to drive large surfaces, and creating an electroacoustic transducer that will produce a high quality sound. The present invention fulfills these needs.

SUMMARY OF THE INVENTION

[0003]

The housing for the high power voice coil and driver mechanism of the transducer of the present invention is made of a rigid non-flexing bottom which supports a flat top designed to flex in a controlled manner as the result of its unique shape. A circular opening in the top allows the voice coil to be centered in its gap by a centering gauge during assembly of the driver mechanism. A cap closes the opening once the voice coil is fixed. The bottom of the housing is designed to remove large amounts of heat from the high power voice coil during operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004]

The exact nature of the present invention as well as its objects and advantages will become readily apparent upon consideration of the following detailed description in conjunction with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

[0005]

Figure 1 is a top plan view of a preferred embodiment of the transducer of the present invention.

[0006]

Figure 2 is a side plan view of the transducer of the present invention.

[0007]

Figure 3 is a bottom plan view of the transducer of the present invention.

[0008]

Figure 4 is an exploded view showing the parts of the transducer of the present invention.

[0009]

Figure 5 is a cross-section taken along line 5-5 of Figure 1 showing the internal parts of the transducer of the present invention in its assembled form.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010]

A preferred embodiment of the electroacoustic transducer 11 of the present invention, and specifically the novel features of the housing for the transducer of the present invention are illustrated in Figures 1, 2 and 3. The transducer 11 of the present invention is designed so that the top portion 15 (Figures 1 and 2) moves, and the bottom portion 13 (Figures 2 and 3)

is rigid, and does not move. By allowing only the top portion to move, the transducer 11 behaves as a monopole transducer.

[0011]

A dipole transducer, on the other hand, one where both the top and bottom surfaces are designed to move, is susceptible to destructive cancellation of energy. Destructive cancellation is an acoustic phenomenon that occurs when sound waves operate out of phase with each other. This can happen when both surfaces, top and bottom, move away from each other. Each surface cancels the energy produced by the other.

[0012]

The transducer 11 of the present invention, by only allowing the top portion 15 of the transducer to move causes the overall energy radiated to be more efficient throughout the utilized band width. The bottom portion 13 is designed to be rigid and to efficiently dissipate heat generated by the transducer 11. For that reason the bottom portion 13 is preferably made from metal, such as cast aluminum, for example.

[0013]

The top portion 15, on the other hand, is designed to flex and move in a controlled manner. The top portion 15 has a unique hexagonal shape with six equal sides 20 that extend from the flat top to the base at an angle 30. In addition to the sloping sides 30 for each of the six sides 20 of the hexagonally shaped top 15, a perpendicular surface area 22 extends from the apex of each of the sides 20 at the top to the base. This particular hexagonal top and side configuration has been found to provide exceptional support for the weight of the transducer 11, especially the weight contributed by the metal bottom portion 13. The entire weight is carried by the top portion 15 when the transducer is mounted vertically to a surface by a bolt 45, or similar fastener.

[0014]

The top portion 15 utilizes a plurality of circular rings 24, 26 which not only provide additional support for top portion 15, but also provide hinge points for top portion 15 to move. A circular cap 17 is mounted over an aperture 46 (Figure 5) by being inserted into a circular groove 16 in top portion 15 (Figure 5). The mounting bolt 45 extends out of cap 17 (see also Figure 5). This bolt mounts the transducer 11 to a surface (not shown) to be driven by the transducer in a manner well known in the art. A plurality of support ribs 28 on cap 17 create additional rigidity and strength to the top portion 15 at the point where it mounts to the surface to be driven.

[0015]

The material used for the top portion 15 is preferably a material that can be molded or machined into the desired shape. The flexible properties of the material used for the top portion are chosen on the basis of the application of the transducer. For example, if the transducer 11 is to produce primarily low frequencies such as desired for subwoofer application, the material for the top portion 15 could be a material that has high flexibility such as a thermal plastic rubber, for example.

[0016]

The transducer of the present invention has been designed to achieve a high force factor. Force generated by the transducer 11 can be calculated from the formula:

$f = bli$

where: f = force

b = flux density of the magnetic gap

l = length of wire in magnetic gap

i = current input into the transducer

[0017]

To achieve a high force factor, the product of flux density of the magnetic gap times the length of the wire in the magnetic gap must be high. Accordingly, the diameter of the coil was chosen to be large. A large diameter coil permits a long length of wire to be in the magnetic gap. In addition to the large diameter conductive coil, the height of the wire windings on the coil is greater by using a thicker top plate that is 8 millimeters thick, for example. In addition to these features, to provide a high force factor, it is preferred that a neodymium magnetic material is used. This material has a very high magnetic strength and thereby provides a high flux density in the magnetic gap of the coil.

[0018]

The high power capability of transducer 11 requires that the resulting heat generated in the conductive coil be transferred to the surrounding metal parts. Adjusting the winding height of the voice coil to the height of the top plate and blackening all the metal parts helps to wick the heat from the voice coil to the surrounding metal parts. To increase heat dissipation, the outside portion 13 of the housing for transducer 11 is powder coated in black and has a plurality of cooling fins 32 extending radially from the center along the outside of the bottom portion 13. Moreover, the voice coil 41 is designed with vent holes 44 (Figures 4 and 5) to allow heat to flow away from the voice coil area out to the cooler metal or the plastic parts, and especially the aluminum bottom portion 13 and the magnetic metal assembly surrounding the voice coil 42 (Figure 5). It is also preferred that the material used for the voice coil is a material designed to handle high temperature and function to isolate the heat generated by the voice coil to the area of the voice coil. Materials such as Kapton or TIL (fiberglass) which are well known in the industry are well suited for this purpose. Other materials may also be used, such as aluminum, for example, for lower temperature applications which provide different acoustical damping characteristics.

[0019]

Referring now to Figures 4 and 5, the preferred structure for the transducer 11 of the present invention including all of its component parts is illustrated. The bottom portion 13 and the top portion 15 of the transducer housing are fastened together along their circumferential periphery to enclose the operative parts of the transducer as illustrated in Figures 4 and 5. A plurality of screws 53 pass through apertures in top portion 15 and thread into threaded apertures in bottom portion 13. A gasket 31 is placed between the two connecting parts of top portion 15 and bottom portion 13. The gasket functions to prevent buzzing noises between the two covers and is also a seal that prevents moisture from entering the housing of the transducer.

[0020]

A bottom plate 33 fastens to the inside of metal bottom portion 13 by a carriage bolt 27 that passes through an aperture in bottom portion 13 and threads into a threaded aperture in bottom plate 33. Bottom plate 33 is made of an electromagnetic material. Bottom plate 33 has an aperture therein which accommodates a magnet 35 which is preferably in disk form. The magnet is preferably made out of neodymium magnetic material. A top plate 37 with a circular aperture 40 through its symmetrical center is fastened to the top of bottom plate 33. The circular aperture 40 exposes the magnet 35 within the bottom plate 33. The top plate 37 is fastened to the bottom plate 33 preferably by threaded screws and glue. A pole cap 39 is placed in the circular aperture of the top plate 37 on top of the magnet 35 within the bottom plate 33. The pole cap 39 has a diameter which leaves a space between its outside circumference and the inner circumference of the aperture 40 in top plate 37. This gap is sufficient to accommodate the voice coil wires 38 wound on voice coil form 41 at its second end. The voice coil has venting holes 44 along its first end. The voice coil wires 38 wound on coil form 41 are located within the circular aperture 40 of top plate 37.

[0021]

The top portion 15 of the transducer housing has a circular aperture 46 (Figures 4 and 5) through its symmetrical center. This aperture allows for centering of the voice coil 41 during assembly by use of a centering gauge (not shown). The centering gauge is inserted in place to align the voice coil in the gap between the pole cap 39 and the circular aperture 40 in top plate 37. The first or upper end of voice coil 41 is glued to the inside surface 42 of the aperture 46 (Figure 5) in the top portion 15 of the transducer housing. A spider 43 is glued to the mid-section of voice coil 41 and to top plate 37. When the adhesives have cured, the voice coil centering gauge is removed and the cap 17 is glued into the groove 16 of the top portion 15 of the transducer housing. A carriage bolt 45 extends through an aperture in cap 17 through a washer 47 on the other side and is fastened down by a hex nut 49. A flexible cover 51 slips over hex nut 49. A rubber boot 19 fits over the connected circumferential perimeter of the top and bottom portions of the housing to further seal out moisture and other impurities from the internal workings of the transducer.

[0022]

Electrical connection to the sealed transducer is obtained by way of cable 23 which has a plug-in connector 25 at one end. The cable 23 passes through a cable grip mechanism 29 that is held to the metal bottom portion 13 of the transducer housing by a nut 21. The wires in cable 23 are connected to the wires 48 of the voice coil.

[0023]

The carriage bolt 45 secured to the cap 17 provides the means for fastening the transducer to a surface to be driven. For example, the transducer can be attached to a flat surface by making a hole through the material and threading a 3/8" nut on the other end, thereby securely sandwiching the flat material between the nut and the transducer. If thicker

material is to be driven by the transducer, a threaded insert may be embedded into the material so that the carriage bolt 45 can be threaded into it.